ANSI S1.20-1988
(ASA 75-1988)
(Revision of ANSI S1.20-1972)

AMERICAN NATIONAL STANDARD

# PROCEDURES FOR CALIBRATION OF UNDERWATER ELECTRO-ACOUSTIC TRANSDUCERS

Standards Secretariat
Acoustical Society of America
335 East 45th Street
New York, New York 10017-3483

# ACOUSTICAL SOCIETY OF AMERICA

# Standards

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**ANSI S1.20-1988**
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# AMERICAN NATIONAL STANDARD
# Procedures for Calibration of Underwater Electroacoustic Transducers

ABSTRACT

This standard establishes measurement procedures for calibrating electroacoustic transducers and describes forms for presenting the resultant data It is a revision of American National Standard S1 20-1972 (R1977). Both primary and secondary calibration procedures are specified for the frequency range from a few hertz to a few megahertz Procedures are specified for determining the measurable characteristics of free-field sensitivity, transmitting response, directional response, impedance, dynamic range, equivalent noise pressure level, and overload pressure level. Equations are given for obtaining the derived characteristics directivity factor, directivity index, efficiency, theoretical equivalent noise pressure level, and quality factor ($Q$) A coordinate system and forms of data presentation are specified so that results may be readily compared and easily understood

**Published for the Acoustical Society of America by the American Institute of Physics**

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These standards are developed as a public service to provide standards useful to the public, industry, and consumers, and to the Federal, State, and local governments

**This standard was approved by the American National Standards Institute as ANSI S1.20-1988 on 4 February 1988.**

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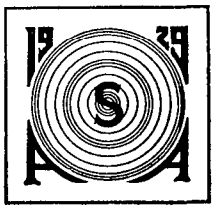

[This Foreword is not a part of American National Standard Procedures for Calibration of Underwater Electroacoustics Transducers, ANSI S1 20-1988 (Revision of ANSI S1 20-1972) (ASA Catalog No 75-1988) ]

This standard establishes measurement procedures for calibrating electroacoustic transducers and describes forms for presenting the resultant data. Both primary and secondary calibration procedures are specified for the frequency range from a few hertz to a few megahertz. A coordinate system and forms of data presentation are specified so that results may be readily compared and easily understood.

This standard was developed under the jurisdiction of Accredited Standards Committee S1, Acoustics, using the American National Standards Institute (ANSI) Accredited Standards Committee Procedures The Acoustical Society of American holds the Secretariat for Accredited Standards Committee S1, Acoustics

Accredited Standards Committee S1, Acoustics, under whose jurisdiction this standard was developed, has the following scope.

> Standards, specifications, methods of measurement and test, and terminology in the fields of physical acoustics, including architectural acoustics, electroacoustics, sonics and ultrasonics, and underwater sound, but excluding those aspects that pertain to safety, tolerance, and comfort

At the time this standard was submitted to Accredited Standards Committee S1, Acoustics, for final approval, the membership was as follows·

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Working Group S1-9, Calibration of Underwater Electroacoustic Transducers, which assisted Accredited Standards Committee S1, Acoustics, in the development of this standard, has the following membership:

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Suggestions for improvements in this standard will be welcomed They should be sent to the Standards Manager, Standards Secretariat, Acoustical Society of America, 335 East 45th Street, New York, NY 10017-3483.

**FIGURES**

# Procedures for Calibration of Underwater Electroacoustic Transducers

## 1 SCOPE

This standard establishes measurement procedures for calibrating underwater electroacoustic transducers and describes forms for presenting the resultant data. It is a revision of American National Standard S1.20-1972 (R1977).

## 2 PURPOSE

To establish procedures for the calibration of underwater electroacoustic transducers.

## 3 APPLICATIONS

**3.1** Primary and secondary calibration procedures are specified for the frequency range from a few hertz to a few megahertz.

**3.2** A coordinate system and forms of data presentation are specified so that results may be readily compared and easily understood.

**3.3** Procedures are specified for determining the measurable characteristics of free-field sensitivity, transmitting response, directional response, impedance, dynamic range, equivalent noise pressure level, and overload pressure level. Equations are given for obtaining the derived characteristics directivity factor, directivity index, efficiency, theoretical equivalent noise pressure level, and quality factor ($Q$).

**3.4** Underwater electroacoustic transducers can be divided into the following groups to show the reasons for these measurements:

Group 1—Sonar echo-ranging, active acoustic tracking, transponder, depth-sounding, communication, and object-locating transducers.

Group 2—Hydrophones, including hydrophone arrays and listening sonar used for noise measurements, propagation studies, and signal analysis.

Group 3—Standard transducers.

Group 4—Auxiliary projectors for measurement purposes.

**3.4.1** Group 1 transducers operate at a single frequency or within a narrow to moderate range of frequencies, when efficiency is important. A single transducer or array is often used for both projecting and receiving. Some transducers are trainable relative to their mounting bracket and enclosure, but most are instead equipped with an electronic scanning device. Large transducers belonging to this group are usually enclosed in a dome.

Commonly measured characteristics of these transducers are transmitting response, free-field sensitivity, impedance, and directional response. Efficiency, directivity index, mechanical $Q$, and acoustic power output are computed. Equivalent noise pressure level, overload pressure level for the normal operating duty cycle, and impedance under pulsing conditions sometimes are required. A description of the performance of auxiliary equipment such as scanning switches and domes may require special types of directional response patterns as defined in 4.4.

Operating conditions may require that measurements be made over a range of temperature and pressure. Hysteretic effects caused by any varying ambient conditions also should be measured.

**3.4.2** Group 2 transducers are usually broadband and usually are designed for minimum self-noise. They may be omnidirectional or directional for measurement of ambient noise. They may be highly directional when used for passive or listening sonar. To minimize self-noise, they may contain a premplifier or transformer for reducing impedance and noise in the electrical circuit.

Commonly measured characteristics of transducers in this group are free-field voltage sensitivity, directional response patterns, and equivalent noise pressure level. Operating conditions may require measurements over a range of temperature and hydrostatic pressure. The hydrophone voltage coupling loss [see 7.18 of American National Standard Acoustical Terminology (Including Mechanical Shock and Vibration), S1.1-1960 (R1976)] may be required. Both magnitude and phase of the sensitivity as a function of frequency may be required of elements of an array or for signal analysis.

**3.4.3** Group 3 transducers are standard hydrophones and reciprocal transducers. Projectors are not often used as standards because a standard hydrophone usually will compensate better for any lack of free-field conditions, or, as expressed another way, projector output sound pressure level for a given vol tage or current input is very dependent on boundary conditions.